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Chelian et al.

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(54) **AUTOMATED MAILBOX**

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B07C 5/38	(2006.01)

(52) **U.S. Cl.**

CPC ***B07C 5/362*** (2013.01); ***A47G 29/1216*** (2013.01); ***B07C 5/38*** (2013.01)

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USPC 700/223

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,261,511	B2	8/2007	Felder et al.
7,381,026	B1	6/2008	Power et al.
7,960,668	B2	6/2011	Fethke et al.
8,238,602	B2	8/2012	Manuel-Devadoss
2007/0233507	A1	10/2007	Publicover
2015/0006005	A1	1/2015	Yu
2015/0112885	A1	4/2015	Fadell et al.
2015/0317597	A1	11/2015	Shucker et al.

FOREIGN PATENT DOCUMENTS

JP	20032100310	7/2003
WO	WO 2015177760	11/2015

OTHER PUBLICATIONS

Wright, Kim; "RoboPost"; https://sites.google.com/kimwrightaerospace/robopost; 1 page.

"Standardised Mailboxes for Robotic Mail Delivery"; 3 pages; 2014.

"Self-Driving Delivery Robot"; Starship Technologies; 3 pages; 2015.

Clifton et al; "Automated Mailbox"; Iowa State University; 47 pages; May 2, 2007.

"Mailmobile Automatic Mail Delivery AGVs"; Egemin Automation Inc.; www.egeminusa.com/pages/agvs/agvs_mailmobile.html; 1 page.

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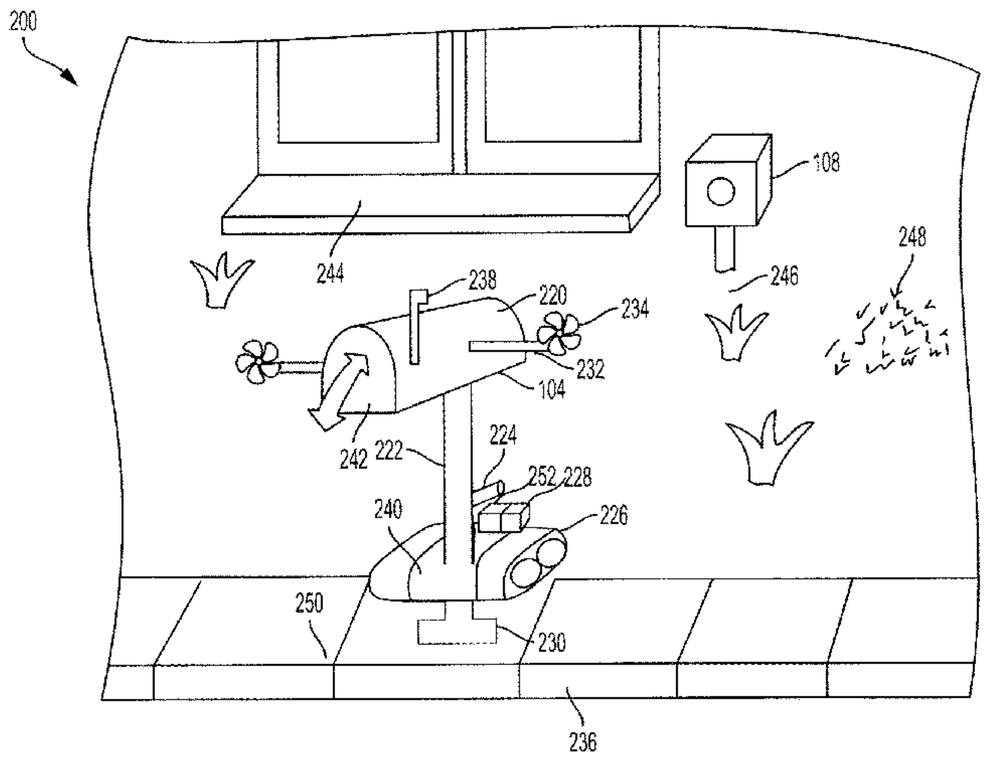
(57) **ABSTRACT**

Methods, systems, and apparatus for an automated mailbox system. The automated mailbox system includes a personal device configured to manage a robot. The robot includes a base that forms a foundation for the robot and is coupled to a post. The robot includes a mailbox having a door. The mailbox is configured to receive documents when in the open position. The robot includes a transportation component that moves the robot in multiple directions among multiple locations. The transportation component is configured to move the robot in a first direction to a first location.

19 Claims, 6 Drawing Sheets



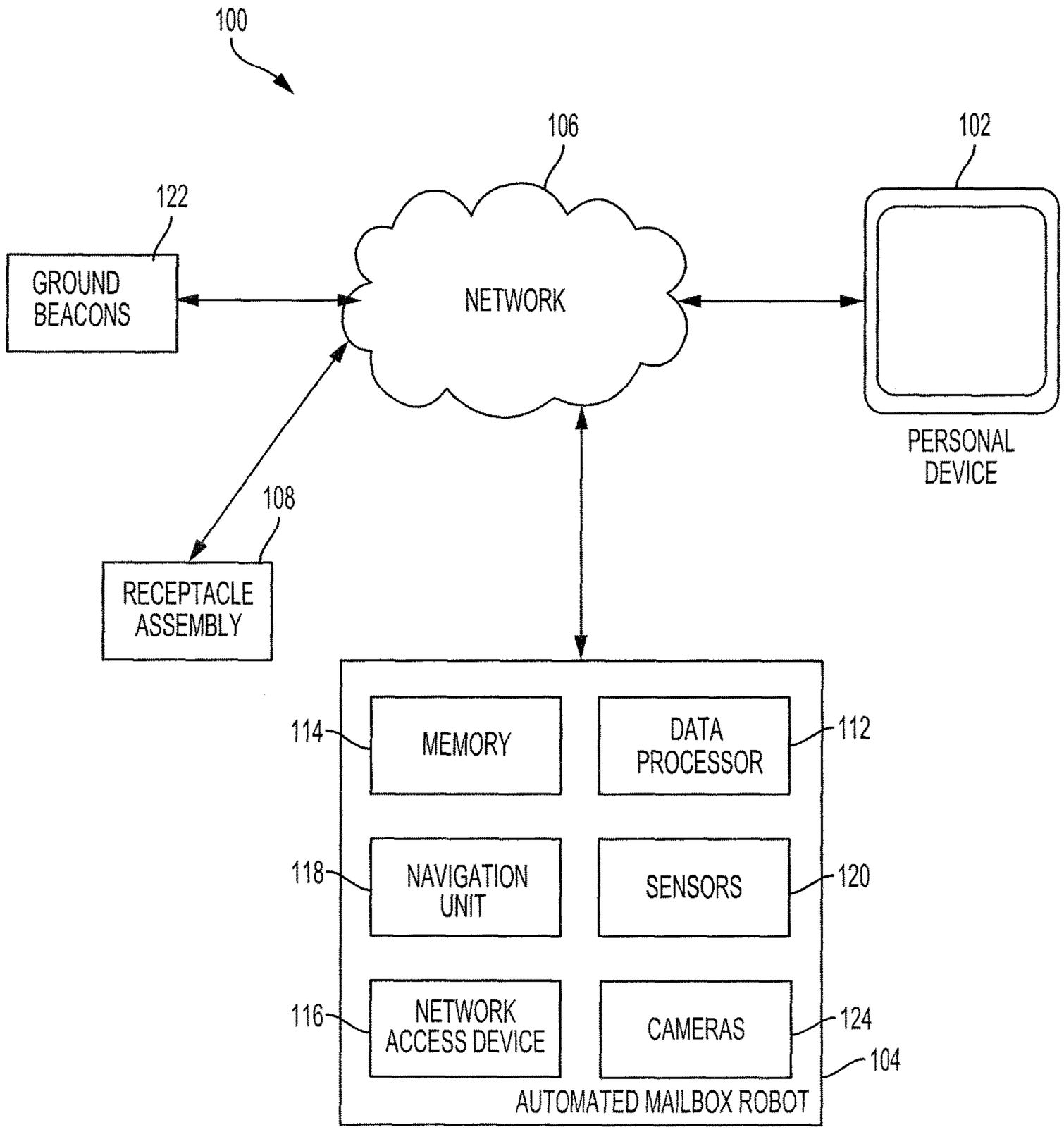

100
106
102
122
GROUND BEACONS
NETWORK
PERSONAL DEVICE
108
RECEPTACLE ASSEMBLY
114
MEMORY
DATA PROCESSOR
112
118
NAVIGATION UNIT
SENSORS
120
116
NETWORK ACCESS DEVICE
CAMERAS
124
104
AUTOMATED MAILBOX ROBOT

FIG. 1

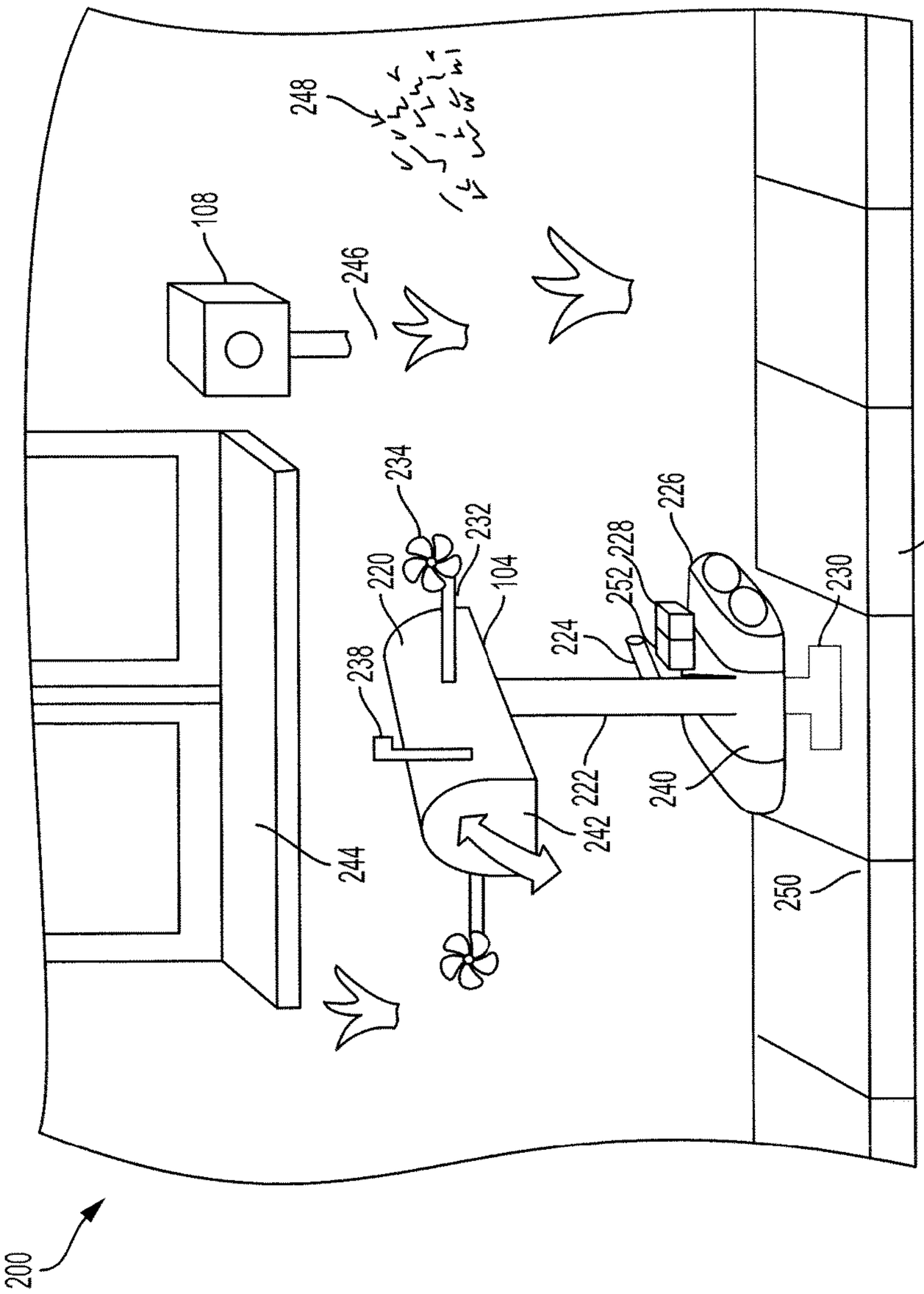

248
108
246
234
232
220
104
226
228
252
224
238
230
236
222
240
242
244
250
200

FIG. 2

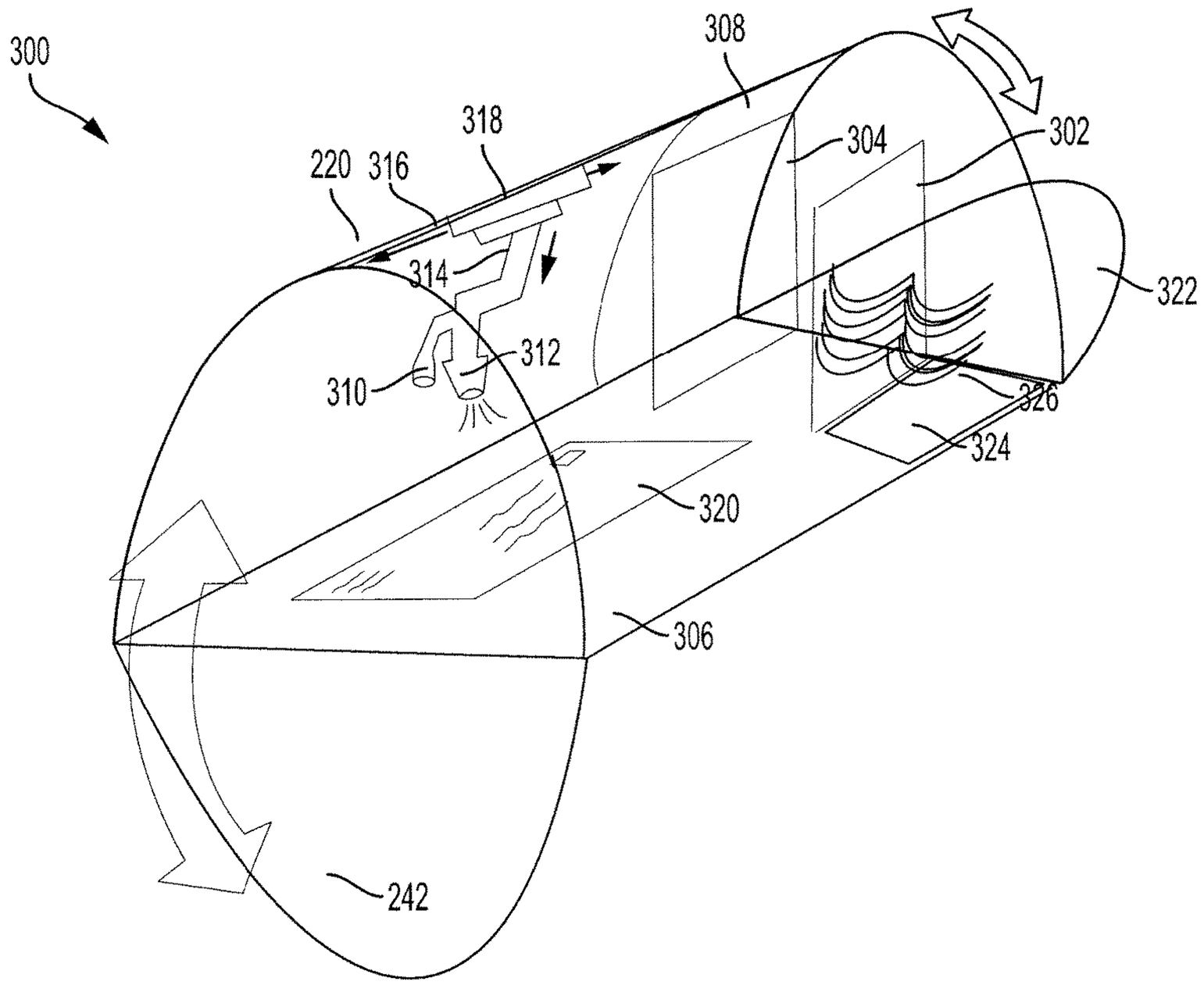


FIG. 3

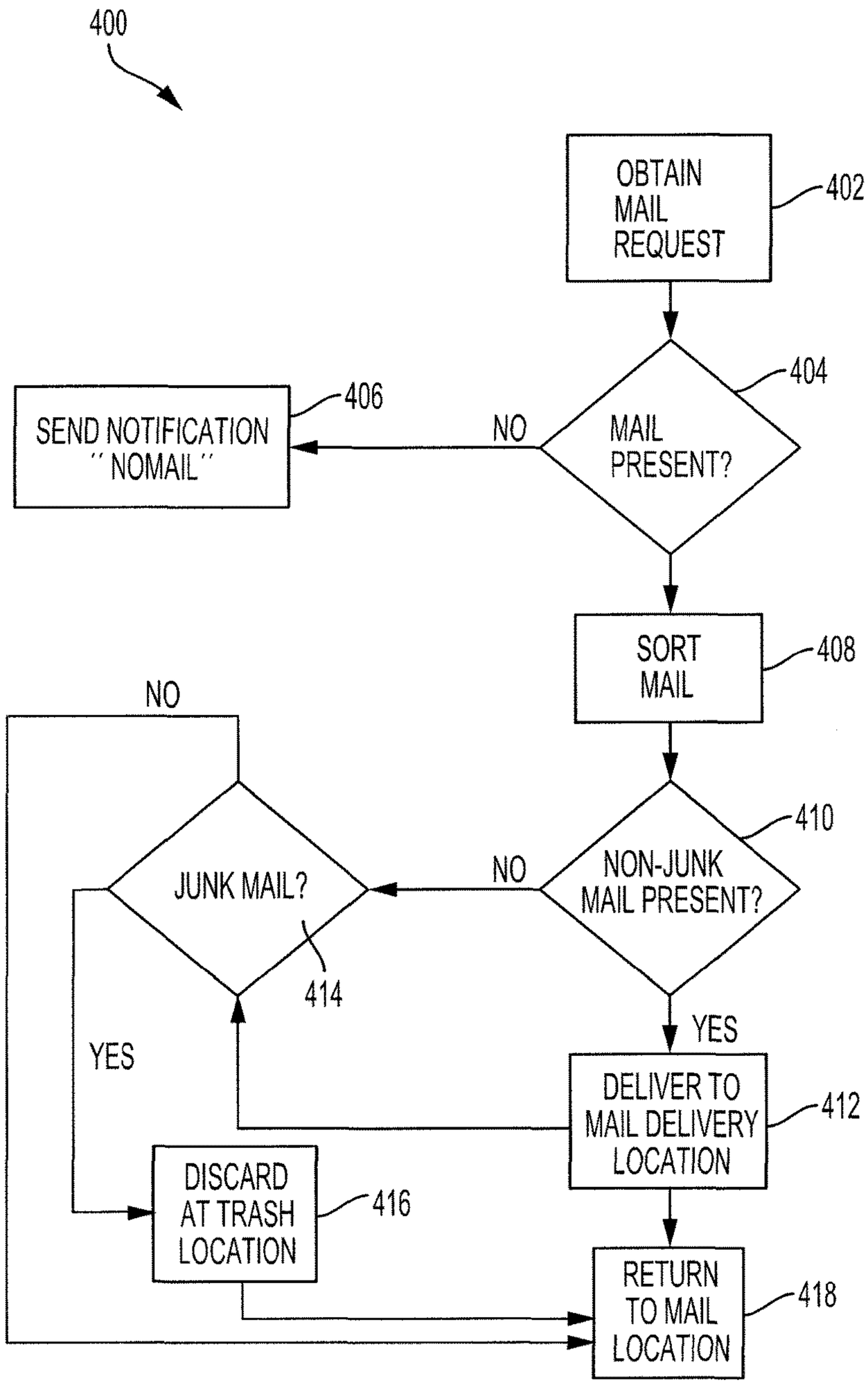

400
OBTAIN MAIL REQUEST
402
MAIL PRESENT?
404
NO
SEND NOTIFICATION "NOMAIL"
406
SORT MAIL
408
NON-JUNK MAIL PRESENT?
410
NO
JUNK MAIL?
414
NO
YES
YES
DELIVER TO MAIL DELIVERY LOCATION
412
DISCARD AT TRASH LOCATION
416
RETURN TO MAIL LOCATION
418

FIG. 4

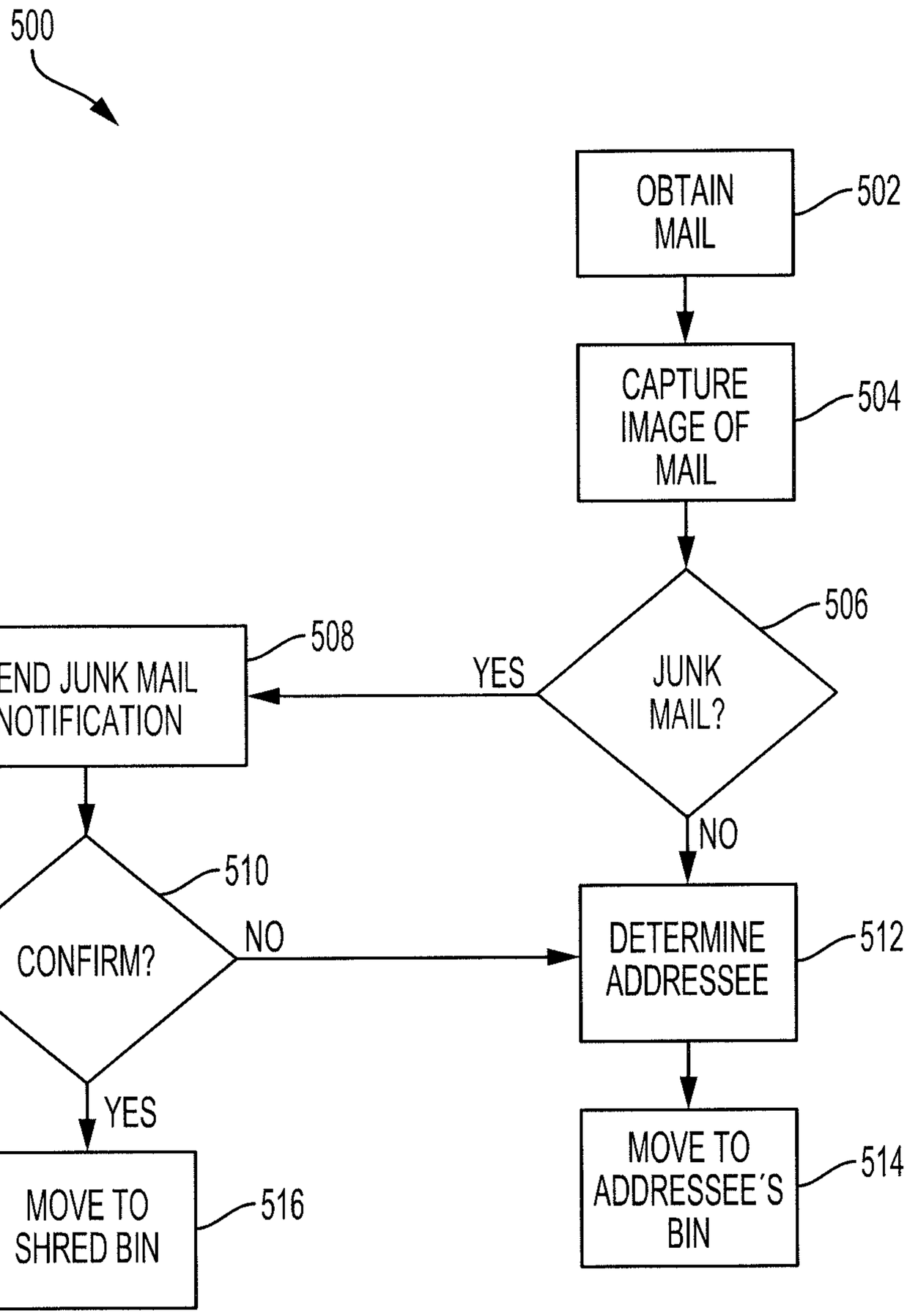

500
OBTAIN MAIL
502
CAPTURE IMAGE OF MAIL
504
JUNK MAIL?
506
YES
SEND JUNK MAIL NOTIFICATION
508
NO
CONFIRM?
510
NO
DETERMINE ADDRESSEE
512
YES
MOVE TO SHRED BIN
516
MOVE TO ADDRESSEE'S BIN
514

FIG. 5

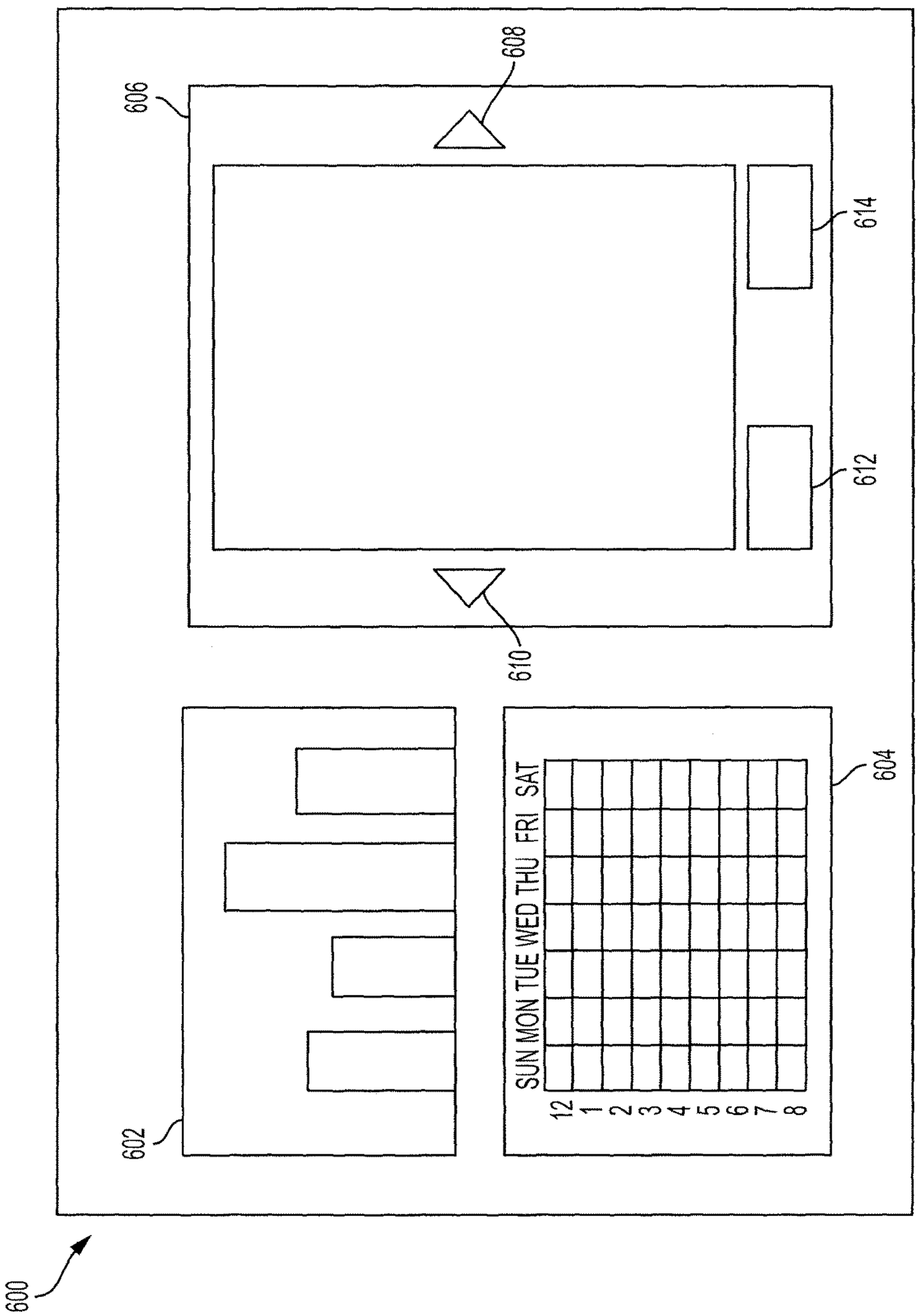

600
602
604
606
608
610
612
614
SUN MON TUE WED THU FRI SAT
12 1 2 3 4 5 6 7 8

FIG. 6

AUTOMATED MAILBOX

BACKGROUND

1. Field

This specification relates to an automatic mailbox robot that automatically sorts, shreds and delivers mail.

2. Description of the Related Art

Businesses, apartments and residences receive large amounts of personal, business and junk mail on a daily basis. Some residents do not have easy access to their mailbox. For example, in rural areas, the mailbox is often located near the main road but the residence may be secluded or far away from the main road. Other obstacles, such as weather or incapacity, may further hinder easy access to the mailbox. For example, a handicapped individual may not have the ability to walk back and forth to a curbside mailbox to retrieve and/or send mail on a regular basis. Additionally, occupants or residents may not have the time or find it tedious to sort through and shred the junk mail.

Accordingly, there is a need for a system and method that automatically sorts, shreds and delivers mail.

SUMMARY

In general, one aspect of the subject matter described in this specification is embodied in an automated mailbox system. The automated mailbox system includes a personal device connected to a network and configured to manage a robot. The robot includes a base that forms a foundation for the robot and is coupled to a post. The robot includes a mailbox connected to the post and having a door that is configured to move between an open position and a closed position. The mailbox is configured to receive documents when the door is in the open position. The robot includes a transportation component that moves the robot in multiple directions among multiple locations. The transportation component is configured to move the robot in a first direction to a first location.

These and other embodiments may optionally include one or more of the following features. The automated mailbox system may include a power source for providing energy to the robot. The automated mailbox system may include a receptacle assembly configured to interface with the robot and provide energy to charge the power source. The robot may include a navigation unit configured to provide navigation information including a current location. The robot may include a navigation unit that uses a GPS device or one or more ground beacons to navigate. The transportation components may be configured to move in the first direction to the first location based on the mailbox having the first document of the first type in the first bin. The transportation component may be configured to move in a second direction to a second location, and the robot may be configured to connect to the receptacle assembly and receive energy to charge the power source. The transportation component may be configured to move the robot in a third direction to a third location to dispose of a shredded document. The post may vertically extend and retract and may include an anchor that may be configured to secure in a structural member to prevent movement of the robot.

One or more processors may be configured to determine that a first document is in the mailbox and determine that the first document is of a first type. The one or more processors may move the first document to a first bin for the first type. One or more processors may be configured to determine that a second document is in the mailbox and determine that the second document is of a second type. The one or more processors may move the second document to a second bin for the second type and shred the second document in the second bin.

One or more processors may be configured to capture an image of the first document and match one or more features of the first document to one or more attributes of the first type to determine that the first document is of the first type. The one or more processors may be configured to move at least a portion of the first document into the first bin using a letter-sorting device.

In another aspect, the subject matter is embodied in a method for sorting and delivering mail. The method includes obtaining, by an automated mailbox at a first location, one or more pieces of mail, each pieces of mail having a first type and a second type. The method includes, for a respective piece of mail of the one or more pieces of mail, capturing one or more images of the respective piece of mail and determining whether the respective piece of mail is of the first type or the second type. The method includes determining whether the respective piece of mail is of the first type or the second type and determining that at least one piece of mail is in the first bin. The method includes transporting the at least one piece of mail from the first location to a second location.

In another aspect, the subject matter is embodied in a method for sorting and delivering mail. The method includes obtaining a mail request that includes an execution date and an execution time. The method includes obtaining a current date, a current time and a current location. The method includes determining whether the piece of mail is of a first type or a second type and transporting the piece of mail in a first direction toward a first location if or when the piece of mail is of the first type and transporting the piece of mail in a second direction toward a second location if or when the piece of mail is of the second type.

BRIEF DESCRIPTION OF THE DRAWINGS

Other systems, methods, features, and advantages of the present invention will be apparent to one skilled in the art upon examination of the following figures and detailed description. Component parts shown in the drawings are not necessarily to scale, and may be exaggerated to better illustrate the important features of the present invention.

FIG. **1** is a block diagram of an example automated mailbox system according to an aspect of the invention.

FIG. **2** is an illustration of an example operational environment for the robot according to an aspect of the invention.

FIG. **3** is an illustration of an example mail sorting and shredding environment within the mailbox according to an aspect of the invention.

FIG. **4** is a flow diagram of an example process for delivering mail according to an aspect of the invention.

FIG. **5** is a flow diagram of an example process for organizing and sorting mail according to an aspect of the invention.

FIG. **6** is an illustration of an example graphical user interface display on a personal device according to an aspect of the invention.

DETAILED DESCRIPTION

Disclosed herein are systems, robots and methods for sorting, shredding and delivering mail. Particular embodi-

ments of the subject matter described in this specification may be implemented to realize one or more of the following advantages. An automated mailbox system automatically retrieves, secures, sorts, shreds and delivers mail. By retrieving mail directly from the mail carrier or sender, the mail is protected until an addressee or mail carrier is able to pick up the mail. For example, the mailbox may have a locking mechanism that prevents the mailbox door from being opened by unauthorized individuals. In another example, the mailbox may be secured to a foundation by an anchor to prevent unauthorized individuals from transporting or stealing the mailbox. Other advantages include the ability to view the contents of the mailbox. This allows a recipient to feel secure that their mail is protected during storage.

Additionally, the automated mailbox system sorts the mail and shreds junk mail, e.g., advertisements, unsolicited mail, or other junk mail. By sorting the mail prior to delivering the mail to the recipient, the automated mailbox system saves the recipient time and effort from having to retrieve and sort through the mail. The automated mailbox system may identify, shred and discard junk mail to also save the recipient time and effort from having to securely dispose of the junk mail.

Other benefits and advantages include the ability to transport the mail between multiple locations, such as the mail delivery location and the mail pickup and/or drop-off location. For example, the mail delivery location may be at the curbside where a mail carrier accesses the mailbox and the mail pickup and drop-off location may be at or near an individual's doorstep to allow easy access of the mailbox. This minimizes the distance an individual, especially those with limited mobility, has to travel to retrieve and send the mail.

FIG. **1** is a block diagram of an example automated mailbox system **100**. The automated mailbox system **100** may include one or more robots **104** having one or more data processors **112**, appropriately programmed, to execute instructions on a computer storage medium, to organize and deliver the mail to the appropriate recipient.

The automated mailbox system **100** includes one or more computers or processors, e.g., a personal device **102**, coupled to one or more robots, e.g., robot **104**, through a network **106**. The automated mailbox system **100** may include one or more ground beacons **122** connected to the network **106**. The network **106**, such as a local area network (LAN), a wide area network (WAN), a cellular network, the Internet, a dedicated short-range communications (DSRC) and/or combinations thereof, connects the one or more computers to the one or more robots **104**. The network **106** may be a wireless network or a wired network.

The personal device **102**, e.g., a smart phone, a cellphone, a personal computer, a tablet, or other communication device of a resident or other occupant of a building, may connect to the robot **104** through the network **106**. The personal device **102** may connect to the robot **104** through an application, such as a mobile device application, or through a resource, such as a webpage. The personal device **102** may control and manage the robot **104** through the application or the resource and may function as an input/output device of the robot **104**. For example, the personal device **102** may command the robot **104** to deliver mail to the recipient, pick up mail from a sender, display one or more images of the received mail, display monitoring information and/or historical information, shred mail, lock and unlock the mailbox, anchor and/or retract the anchor of the robot **104** and/or perform other functions associated with organizing, sorting, shredding and/or delivering the mail. The personal device **102** may provide operational data to the robot **104** through the network **106** to configure the robot **104**. In some implementations, the operational data is programmed at the factory.

Operational data is data that assists the robot **104** to perform the functions of sorting, shredding and/or delivering mail. The operational data may include pre-programmed data to perform functions, such as navigation or setting configurations. The operational data may include navigational information, a schedule, and/or configuration settings. In some implementations, the operational data may be transmitted wirelessly directly from the personal device **102** to the robot **104**.

Navigational information describes a route for the robot **104** to travel to transport the mail among one or more locations. For example, the route may direct the robot **104** to remain idle at a first location, such as by the curbside to wait for mail delivery. The robot **104** may receive mail from a mail carrier and travel to a second location, such as the doorstep of a residence to deliver the mail and/or pickup outgoing mail. The robot **104** may then travel to a third location to shred any junk mail. Afterwards, the robot **104** may return to the first location. A mail carrier is any device, vehicle or person who delivers mail. Mail includes, but is not limited to, packages, documents, advertisements, and/or unsolicited mail.

A location may include map coordinates, e.g., latitude and longitude coordinates, or may be a relational location relative to one or more ground beacons. An example relational location may be a location 1 foot left of a first ground beacon and 2 feet right of a second ground beacon. The one or more locations may be user configurable.

Operational information may include a schedule. The schedule may be programmed by a user of the personal device **102**. The schedule may describe the location of the robot **104** at a particular time. The route of the robot **104** may be based on the schedule. For example, the robot **104** may be scheduled to idle at the mail delivery location in the afternoon every weekday between 1 p.m. and 4 p.m. because mail is delivered between those times, and in the evenings, the robot **104** may be scheduled to return to the home location to charge and await an indication by a user to deliver the mail to a mail pickup and/or drop-off location. One or more users can be on the schedule for delivery of the mail to the same or different pickup and/or drop-off locations. For example, if three roommates share a house or an apartment, the robot **104** may deliver their respective mail to each of their bedrooms or designated mail delivery location.

The schedule may also describe when to perform one or more additional functions such as a lockdown function. The lockdown function may lock the mailbox during specific scheduled hours and may anchor the robot **104** to a foundation, such as the curbside, by extending a post of the robot **104** into the foundation. For example, "John Doe" may schedule a lockdown of the mailbox when he plans to travel for Christmas week.

Configuration settings may include one or more notification settings for when to send one or more notifications to a user of the personal device **102**. Notifications may include an indication that mail has been delivered by the mail carrier, an indication that a piece of mail may be junk mail, an indication that the battery is low on power, an indication that one or more bins has reached a particular capacity, an indication that the robot **104** has been tampered with or is malfunctioning, and/or an indication that the mail has been picked up. The notification may include additional information. The additional information may include a date/time

stamp, a captured image of the piece of mail, an image of the inside of the mailbox or the area surrounding the mailbox, capacity information and/or power information.

The automated mailbox system **100** may include a receptacle assembly **108**, e.g., an electrical outlet for providing power to the robot **104**. The receptacle assembly **108** may charge a battery of the robot **104**. The receptacle assembly **108** may be coupled to a power source, such as a solar panel or other power source. The receptacle assembly **108** may have a connector that interfaces with another connector on the robot **104** to charge and/or provide instructions to the robot **104**. The connector may be a female connector or a male connector that connects to a corresponding male connector or female connector, respectively, of the robot **104**. The connector may include one or more electrical contacts that are made of electrically conductive material, e.g., copper wire, and may electrically connect the receptacle assembly **108** to the robot **104** to charge the robot **104**. The personal device **102** may provide operational data to a receptacle assembly **108** through the network **106** to configure the robot **104**. In some implementations, the personal device **102** may transmit the operational data directly to the robot **104**.

The robot **104** may include a memory **114**, one or more data processors **112**, a network access device **116**, a navigation unit **118** and/or one or more sensors **120**. Other components of the robot **104** may be described in further detail in reference to FIG. **2**.

The memory **114** may store instructions to execute on the one or more data processors **112** and may include one or more of a RAM or other volatile or non-volatile memory. The memory **114** may be a non-transitory memory or a data storage device, such as a hard disk drive, a solid-state disk drive, a hybrid disk drive, or other appropriate data storage, and may further store machine-readable instructions, which may be loaded and executed by the one or more data processors **112** that may be coupled to the memory **114**.

The robot **104** may include one or more data processors **112** coupled to at least one of a navigation unit **118**, a network access device **116** and/or one or more sensors **120**. The navigation unit **118** may include a Global Positioning System (GPS) device. The navigation unit **118** may perform navigation functions. Navigation functions may include, for example, providing navigation instructions, providing a route, providing a current location of the robot **104**, and providing date/time information.

The robot **104** may include a network access device **116** that may be coupled to the one or more data processors **112**. The network access device **116** may be configured to allow the robot **104** to connect to the personal device **102** to receive management and control information, such as instructions to deliver the mail, notifications, operational data, and other instructions associated with organizing, sorting, shredding and/or delivering mail.

The robot **104** may include one or more sensors **120** that may be coupled to the one or more data processors **112**. The one or more sensors **120** may include a capacity sensor, a temperature sensor, a battery sensor, and/or one or more ground sensors. The capacity sensor may detect the amount of storage available or used by the robot **104** for storing mail and/or shredding mail. The temperature sensor may detect the temperature outside the mailbox so that the robot **104** may provide that information to the personal device **102**. The battery sensor may detect the amount power remaining to operate the robot **104**. The ground sensors may be may be used to navigate the robot **104** among the one or more locations guided by the one or more ground beacons **122**.

The robot **104** may include a navigation unit **118** that may obtain a current location of the robot **104**. The robot **104** may use the navigation unit **118** to guide the robot **104** among the one or more locations. The one or more location may be inputted by a user on the personal device **102** and obtained by the robot **104**. In some implementations, the one or more sensors **120** interact with the one or more ground beacons **122** to guide the robot **104**.

FIG. **2** is an illustration of an example operational environment **200** of the robot **104**. One or more computers or one or more data processing apparatuses, for example, the one or more data processors **112** or the navigation unit **118** of the automated mailbox system **100** of FIG. **1**, appropriately programmed, may operate the robot **104** to sort, shred, and/or deliver mail.

The operational environment **200** includes the robot **104**, the receptacle assembly **108**, and one or more locations, such as a mail delivery location **250**, a home location **246**, a mail pickup and/or drop-off location **244**, and/or a trash location **248**. The mail delivery location **250** is the place where the robot **104** delivers the mail to and receives mail from the mail carrier, such as the curbside. The home location **246** is the place where the robot **104** may connect to the receptacle assembly **108** to charge. The mail pickup and/or drop-off location **244** is the location where the addressee receives the mail or the addresser places the mail into the mailbox **220**, e.g., the doorstep of a residence. The mail pickup and/or drop-off location **244** may be the same or different location as the home location **246**. The trash location **248** is the location where the robot **104** disposes of shredded junk mail. The junk mail may include solicitations, advertisements, or bulk mail.

The robot **104** includes a mailbox **220** and one or more transportation components **226**, e.g., one or more wheels, one or more flight rotors **234**, and/or one or more treads. A mailbox is a storage container that holds one or more pieces of mail. The robot **104** may include a base **240**, a post **222**, a battery **228**, a motor **252**, an anchor **230** and a receptacle assembly connector **224**.

The mailbox **220** may be coupled to a post **222**. The mailbox **220** stores one or more pieces of mail and may have one or more bins. The mailbox **220** may have one or more devices to perform sorting, shredding and/or delivery of the one or more pieces of mail. The mailbox **220** has a front door **242** at one end of the mailbox **220** and may have a back door (not shown) at an opposite end of the mailbox **220**. The operation of the one or more devices and the one or more doors may be further described in more detail in reference to FIG. **3**.

The mailbox **220** may be coupled to a distinct transportation component, such as one or more flight surfaces **232** and one or more flight rotors **234**. The flight rotors **234** and mailbox **220** may decouple from other components of the robot **104**, such as the post **222** and/or the base **240**, and propel through the air. The one or more flight rotors **234** may rotate about an axis to create propulsion to propel the mailbox **220** through the air. The propulsion may be in a direction that is along the perpendicular axis of the mailbox **220**.

A mailbox flag **238** may be connected to the mailbox **220**. The mailbox flag **238** may be moved between a down position and an up position. The down position, for example, may indicate that there is no mail in the mailbox **220**. The up position, for example, may indicate that there is mail in the mailbox **220**. The mailbox flag **238** may be configured to turn on or off a letter-sorting device in the mailbox **220**. In addition, the mailbox flag **238** may be automatically acti-

vated when an unused stamped letter or package is placed in the mailbox **220** and automatically deactivated when the mail carrier removes the unused stamped letter or package from the mailbox **220**. The mailbox **220** can also send a notification to the personal device **102** indicating to the user that the stamped letter or package has been taken by the mail carrier.

The mailbox **220** may be coupled to a post **222**. The post **222** may be made of wood, metal, plastic, carbon fiber, or any other rigid material. The post **222** may be connected to the bottom surface of the mailbox **220** and extend through the base **240** into the foundation **236**. One end of the post **222** may have an anchor **230** that embeds into a cavity of the foundation **236**. The anchor **230** may be retractable and/or extendable. That is, the anchor **230** may extend below the base **240** and embed into the foundation **236** or may be drawn upward back into the post **222** and/or the base **240** so that the anchor **230** does not impede movement of the robot **104**. When retracted, the anchor **230** may collapse into a shape to be stored in the base **240** and/or the post **222**. The anchor **230** may be made of metal, such as steel or iron, or other rigid material. The anchor may be "T" shaped, "X" shaped or any other shape designed to embed in a cavity in the foundation **236**. The foundation **236** may be made of concrete, earth, rock, sand or any other medium for placement of a mailbox.

One or more batteries **228** may be coupled to the base **240**. The one or more batteries **228** may provide power to operate the one or more devices in the mailbox **220** and/or the motor **252** to move the robot **104** using the one or more transportation components **226**. A power source, such as the receptacle assembly **108** or a solar panel, may be connected to the robot **104** to charge the one or more batteries **228**. In some implementations, the robot **104** has an electrical cord that connects to the receptacle assembly **108**. The one or more batteries **228** supply power to the motor **252** to operate the one or more transportation components **226**.

The robot **104** may include one or more transportation components **226** to move among the one or more locations. The transportation components **226** may use one or more treads or one or more wheels connected to the base **240** to move among one or more locations. The transportation component **226** may move in multiple directions. The transportation component **226** may be coupled to the base **240**. The base **240** may rotate the transportation components **226** to direct the robot **104** in the different directions. In some implementations, the individual transportation component, such as a wheel, is rotated to direct the robot **104** in the different directions. One or more actuators may be used to rotate the one or more wheels or the base **240**. The transportation component **226** may be configured to lock and prevent movement of the one or more wheels or the one or more treads.

FIG. **3** is an illustration of an example mail sorting and shredding environment **300** within the mailbox **220**. One or more computers or one or more data processing apparatuses, for example, the one or more data processors **112** of the automated mailbox system **100** of FIG. **1**, appropriately programmed, may operate to sort and shred the mail within the mailbox **220**.

The mailbox **220** has a front door **242** connected to a front portion **306** of the mailbox **220** and may have a back door **322** connected to a back portion **308** of the mailbox **220**. The front door **242** may be at one end of the mailbox **220**, and the back door **322** may be at the opposite end of the mailbox **220**.

The front door **242** and the back door **322** may move between an open position, a partially open position, and a closed position. When either door is in the open position or the partially open position, one or more pieces of mail may be placed in the mailbox **220**. When the front door **242** is in the closed position, there may be no access to the inside of the mailbox **220** from the front portion **306**. When the back door **322** is in the closed position, there may be no access to the inside of the mailbox **220** from the back portion **308**. The front door **242** and the back door **322** may have a locking mechanism, e.g., a deadbolt, and/or a door biasing apparatus. The locking mechanism is configured to lock the front door **242** and/or the back door **322** in the closed position preventing access to the inside of the mailbox **220**. The door biasing apparatus may bias the front door **242** and/or the back door **322** into the closed position when the doors are in the partially open position or the open position.

The front door **242** provides access to the front portion **306**. The front portion **306** may form a cavity to create an entrance for one or more pieces of mail **320**. Inside the front portion **306**, there may be a sorting apparatus **318** that may move back and forth along the longitudinal axis of the mailbox **220** using one or more rails **316** or rollers on the ceiling of the mailbox **220**. The sorting apparatus **318** may include one or more cameras **310** and one or more letter-sorting devices **312**, such as a suction device, coupled to an arm **314** that may extend and retract the one or more cameras **310** and/or the one or more letter-sorting devices **312** relative to the position of the one or more pieces of mail **320**. In some implementations, the one or more cameras **310** and the one or more letter-sorting devices **312** are on different arms. In some implementations, the one or more cameras **310** are on the inside surface of the mailbox **220** and not on an arm.

The one or more cameras **310** may be used to capture images of the one or more pieces of mail **320** to sort. The one or more letter-sorting devices **312** may move the one or more pieces of mail **320** into a position to capture the one or more images and/or move the one or more pieces of mail **320** into one or more bins in the back portion **308**.

The back portion **308** may have one or more bins formed using one or more dividers **302** and **304** that segregate a cavity formed within the back portion **308**. The one or more dividers **302** and **304** may be vertical dividers or horizontal dividers to create the one or more bins in a vertical configuration or a horizontal configuration, respectively. The one or more bins may be used to store the sorted and/or shredded mail, e.g., a shred bin, or an addressee bin. The shred bin, i.e., the bin storing the mail to be shredded, may include a shredder **326** that is configured to shred junk mail.

The back portion **308** may have a trapdoor **324** in the shred bin that may be configured to move between an open position and a closed position to allow shredded mail to drop into the trash location **248**. In some implementations, the shred bin may be in the front portion **306**, a side portion, a top portion or a bottom portion, of the mailbox **220**.

FIG. **4** is a flow diagram of an example process for delivering mail. One or more computers or one or more data processing apparatuses, for example, the one or more data processors **112** or the navigation unit **118** of the robot **104** of the automated mailbox system **100** of FIG. **1**, appropriately programmed, may perform the process **400**.

The system **100** obtains a mail request (**402**). The mail request may be a request for the robot **104** to return to the home location **246**, return to the mail pickup and drop-off location **244**, return to the mail delivery location **250**, or lock or unlock the mailbox **220**. The mail request may include a

date and time and/or a location. If the mail request is a request to return to the home location **246** and/or the mail delivery location **250**, the robot **104** travels to the home location **246** and/or the mail delivery location **250**, respectively. If the mail request is a request to return to the mail pickup and/or drop-off location **244**, the robot **104** performs the sorting functions.

The system **100** may receive a mail request from a personal device **102** through the network **106**. The system **100** may obtain the mail request from a schedule. The schedule may be pre-programmed. The system **100** may obtain a current date and time from an internal clock or from the navigation unit **118** using, for example, a GPS device. The system may extract, from the mail request, the delivery date and time and/or delivery location and execute the request when the current date and time is the same as the extracted date and time in the mail request. In some implementations, the mail request may be executed immediately.

The system **100** may determine that the request is a request to return to the mail pickup and/or drop-off location. The system **100** may determine whether the mailbox has mail (**404**). The system **100** may use the one or more sensors **120** and/or the one or more cameras **310** to determine whether the mailbox has mail. The system **100** may capture one or more images of the inside of the mailbox **220** and send the one or more images to the personal device **102**. The system **100** may request confirmation that there is mail in the mailbox **220**. The system **100** may receive user input that indicates that there is mail in the mailbox **220**.

In some implementations, the mailbox **220** may contain a weight sensor at the bottom surface of the mailbox **220**, and if the weight is greater than or equal to a threshold value, the system **100** determines that there is mail in the mailbox **220**. In some implementations, a volume sensor at the top of the mailbox (e.g., a camera or ultrasound sensor) may serve a purpose similar to the weight sensor.

If the system **100** determines that there is no mail, the system **100** may send a notification to the personal device **102** that indicates that there is no mail (**406**). The notification may include an image of the inside of the mailbox **220**. The notification may display the image of the inside of the mailbox **220** on the personal device **102** through an application, e.g., mobile device application, or a web browser. In some implementations, the notification may be an audio notification, such as a beep, a chime, a voice notification, or any other user-configurable audio notification.

The system **100** may sort one or more pieces of mail into one or more bins. The system **100** may sort the one or more pieces of mail based on the position of the mailbox flag **238** or the mail request (**408**). If the mailbox flag **238** is in the up position that may indicate that there is outgoing mail so the sort functionality may be turned off. If the mailbox flag **238** is in the down position that may indicate that there is no outgoing mail so the sort functionality may be turned on. The one or more bins may include a shred bin, an incorrect addressee bin, and/or one or more addressee bins. The system **100** may sort the one or more pieces of mail into the one or more bins based on one or more attributes. The one or more attributes may include the addresser's information, the addressee's information, the colors of the document, and/or one or more markings on the document. For each piece of mail, the system **100** may determine whether the piece of mail is junk mail, an incorrectly addressed mail, or mail to be delivered to an addressee based on the one or more attributes.

Each of the one or more addressee bins may correspond to one or more addressees or persons located at the mail pickup and/or drop-off location. For example, if "John Doe," "Jane Doe," and "James Doe" pickup their mail at the mail pickup and/or drop-off location **244**, a bin may be assigned to each person. The assignment of the one or more bins may be user-configurable and may be assigned using the personal device **102**. In some implementations, the one or more addressees may be assigned to a single bin. For example, the entire "Doe family" may be assigned to one bin. The number of assignments may be limited only by the number of bins and the number of addressees.

The shred bin is designated for junk mail that is scheduled for shredding and disposal at the trash location **248**. The incorrect addressee bin is designated for mail with an addressee or address that does not correspond to the mail pickup and/or drop-off location. The addressees and/or addresses that correspond to the mail pickup and/or drop-off location may be user-configurable and may be configured using the personal device **102**. The system **100** analyzes each piece of mail to determine the bin in which the piece of mail belongs which is further described in reference to FIG. **5**.

The system **100** may determine whether there is mail in the one or more non-shred bins (**410**). The system **100** may use one or more sensors, e.g., a weight sensor, to determine if mail is in the one or more non-shred bins. For example, if the weight in one of the non-shred bins is greater than or equal to a threshold value, which may indicate there is mail in the bins. Similarly, a volumetric sensor can determine if there is mail in the one or more non-shred bins.

If there is mail in the one or more non-shred bins, the system **100** delivers the mail to the mail pickup and/or drop-off location **244** (**412**). The system **100** may obtain the location of the mail pickup and/or drop-off location **244** from one or more configuration settings programmed from the personal device **102**. In some implementations, the system **100** may obtain the location of the mail pickup and/or drop-off location **244** from the mail request. In some implementations, the system **100** follows one or more ground beacons **122** to the mail pickup and/or drop-off location **244**. The system **100** may receive sensor information from the one or more ground beacons **122** that may guide the robot **104** among the one or more locations. The robot **104** may retract an anchor **230** into the base **240** and use energy from the battery **228** to move the transportation components **226**, such as the one or more treads and/or the one or more flight rotors **234**, in one or more directions toward the mail pickup and/or drop-off location **244**.

The system **100** may determine whether there is junk mail in the shred bin (**414**). The system **100** may determine that there is junk mail based on the used capacity of the shred bin. The system **100** may detect the used capacity of the junk mail bin based on the weight or volume of the junk mail in the shred bin. If the weight or volume is greater than a threshold amount, the system **100** may determine that there is junk mail.

If there is junk mail in the shred bin, the system **100** transports the junk mail to the trash location, shreds the junk mail, and disposes of the shredded junk mail at the trash location **248** (**416**). In some implementations, the system **100** may shred the junk mail immediately after the system **100** determines that the mail is junk mail or upon a request from the personal device **102**. After the system **100** delivers the mail to the mail pickup and/or drop-off location **244** or the trash location **248**, the system **100** may return to the mail delivery location **250** (**418**). The system **100** may return to the mail delivery location **250** based on user input on the personal device **102** or based on determining that there is no

mail in the mailbox **220**. The system **100** may determine that there is no mail remaining in the mailbox **220**, using, for example, a weight sensor, and determining that the weight of any contents in the mailbox **220** is below a threshold amount. The system **100** may return to the home location **246** if the system **100** determines that the power is low based on a battery sensor.

FIG. **5** is a flow diagram of an example process for sorting and shredding mail. One or more computers or one or more data processing apparatuses, for example, the one or more data processors of the mailbox **220** of FIG. **2**, appropriately programmed, may perform the process **500**.

The system may obtain mail (**502**). The system **100** may allow the front door **242** to be placed into an open position by unlocking the locking mechanism of the front door **242**. By placing the front door **242** into the open position, an open cavity at a front portion **306** of the mailbox **220** is exposed allowing one or more pieces of mail to be placed into the front portion **306** of the mailbox **220**. The system **100** may determine that the mail is incoming mail. That is, the mail is being received by an addressee at the mail pickup and drop off location based on the mail flag **238**.

The system **100** may determine whether the obtained mail includes a package. The system **100** may capture an image of the obtained mail within the mailbox **220**, and determine if the image is of a package by comparing, for example, the physical dimensions of the mail using one or more sensors to measure the dimensions. The system **100** may alert the personal device **102** that there is a package for pickup or use the letter-sorting device **312** to move the package to a bin so as not to shred or dispose of the package prior to sorting, shredding and delivering of the one or more other pieces of mail.

The system **100** captures one or more images of one or more pieces of mail placed into the mailbox **220** (**504**). The system **100** may adjust the one or more pieces of mail placed into a position such that one or more cameras may capture the one or more images. The system **100** may use the letter-sorting device **312** to move the one or more pieces of mail from one location to another location or from one position to another position. In some implementations, the one or more cameras **310** and/or the letter-sorting device **312** are coupled to an arm **314** that may extend and retract vertically from a sorting apparatus **318**. The arm **314** may rotate using an actuator to allow the one or more cameras **310** to view multiple angles and perspectives of the one or more pieces of mail and to allow the letter-sorting device **312** to move the one or more pieces of mail.

Certain attributes, such as multiple different colors of different intensities, addressee information that does not include an individual's or organization's name, e.g., "Residence of," standardized typeface, and/or markings, such as logos or images, may indicate that the mail is junk mail.

The system **100** may determine whether a piece of mail is junk mail based on the captured image of the piece of mail and one or more attributes (**506**). The system **100** analyzes a piece of mail for one or more attributes to determine whether the piece of mail is junk mail. The one or more attributes may include the color intensities of the piece of mail, the addressee's information, the addresser's information, the typeface on the piece of mail, the lack of a specific name on the addressee's information, and/or one or more other markings on the piece of mail. The system **100** may use the one or more sensors and/or cameras to analyze the color intensities and typeface on the piece of mail. A highly colorful document may indicate a greater likelihood the piece of mail is junk mail. For example, a grocery advertisement has various objects that have multiple colors, whereas, an addressed manila envelope is plain. Thus, the advertisement is more likely junk mail than the manila envelope.

The system **100** may evaluate the typeface to determine if the piece of mail is junk mail. For example, a handwritten typeface may indicate that the piece of mail is personalized and not mass-mailed. On the other hand, use of a printed font may be an indication that the document was mass-mailed and is junk mail.

The system **100** may detect one or more other markings on the piece of mail, such as an emblem, image, or a logo, or an indication that the piece of mail is bulk mail or solicitation mail, and determine from the one or more other markings that the piece of mail is junk mail.

The system **100** may determine the addressee information and/or the addresser information from the piece of mail by, for example, performing optical character recognition (OCR) on the piece of mail. The system **100** may identify from the addresser information a name and address of the addresser and from the addressee information a name and address of the addressee.

The system **100** may compare the name and/or address of the addresser to a junk mail list, and if the name and/or address of the addresser appear on the junk mail list, the system **100** may identify the piece of mail as junk mail. The junk mail list may be user configurable. That is, an addressee may be added, modified, and/or removed from the list by a user of the personal device **102**. In some implementations, the system **100** may automatically add or remove an addresser based on a user confirmation that a document is junk mail when a captured image of the piece of mail is presented to a user on the personal device **102**. In some implementations, the system **100** may determine if the addressee is a generic addressee. If the name of the addressee is generic, the system **100** may determine that the piece of mail is junk mail.

In some implementations, each of the one or more attributes may have a weighting factor. The system may determine that the piece of mail is junk mail based on a calculation of a junk mail score, which may be a function of each of the one or more attributes and their weighting factors. If the junk mail score is greater than or equal to a threshold score, the system **100** may determine that the piece of mail is junk mail. The threshold score and weighting factors may be user configurable.

If the system **100** determines that the piece of mail is junk mail, the system **100** may send a notification to the personal device **102** (**508**). The notification may include the captured image of the piece of mail, and may include a confirmation request. The confirmation request may include one or more user interface elements, such as a button, to receive user input that identifies whether the piece of mail is junk mail, an addressee's mail, and/or mail to an incorrect addressee. In some implementations, the notification may provide additional information, such as the addressee, the addresser, and/or additional captured images of the piece of mail. The additional captured images may be scrolled through by selecting one or more user interface elements, such as one or more buttons.

The system **100** may validate that the mail is junk mail based on a response to the confirmation request (**510**). If the response confirms that the piece of mail is junk mail, the system **100** moves the piece of mail to the shred bin and may add the addresser to the junk mail list (**516**). If the response indicates that piece of mail is not junk mail, the system **100** may determine the addressee of the piece of mail.

The system **100** may determine the addressee by scanning or capturing an image of a portion of the document associated with the addressee information (**512**). The system **100** may perform OCR on the scanned or captured image and extract a name and/or address from the addressee information.

The system **100** may compare the extracted name and/or address to a list of known addressee's for the mail pickup and/or drop-off location **244** and determine whether the addressee is registered to the mail pickup and/or drop-off location **244**. An addressee may be registered using the personal device **102**. If the addressee is on the list, the system **100** may move the piece of mail to one or more bins associated with the addressee (**514**). If the addressee is not on the list, the system **100** may move the document to an incorrect addressee bin. In some implementations, there are not individual bins associated with each addressee and/or an incorrect addressee bin, but instead only a shred bin and/or non-shred bin.

FIG. **6** is an illustration of an example graphical user interface (GUI) display **600** of a personal device **102**. One or more computers or one or more data processing apparatuses, for example, the one or more data processors **112** of the automated mailbox system **100** of FIG. **1**, appropriately programmed, may implement the graphic user interface display **600** on the personal device **102**.

The GUI display **600** may be configured to display notifications, user configurable settings, monitoring information, schedule information, and/or one or more captured images. The GUI display **600** may have one or more display frames, e.g., display frames **602**, **604**, and **606**. The one or more display frames may display the notifications, the user configurable settings, the monitoring information, the schedule information, and/or the one or more captured images. For example, the display frame **602** displays the monitoring information, the display frame **604** displays the schedule information, and the display frame **606** displays a captured image. The display frame, e.g., the display frame **606**, may have one or more buttons, e.g., buttons **608** and **610**, to scroll through the one or more captured images and/or the one or more displays. For example, a display frame may scroll between different displays of different information, such as the monitoring information, the scheduling information, or the one or more captured images. In another example, the display frame **606** scrolls through different images captured by the one or more cameras. Selection of the button **610** may scroll the display in the display frame **606** to a previous image and the selection of the button **608** may scroll the display in the display frame **606** to the next image. Other buttons, e.g., buttons **612** and **614**, may be used to confirm or cancel the shredding of one or more pieces of mail.

The monitoring information may include information describing the capacity of each of the one or more bins inside the mailbox **220** and/or health information of the robot **104**. For example, the monitoring information may include a percentage or an amount of the used capacity in the shred bin, a percentage or an amount of the used capacity in the one or more addressees' bins, and/or a percentage or an amount of power remaining in the battery. The schedule information may include information describing the date/time that the robot **104** is at or travels to one of the one or more locations. The health information may include information describing any software or hardware faults.

The GUI display **600** may be configured to receive user input to send to the robot **104**. User input may include user configurable settings for setting the threshold capacity before a notification is sent and/or a threshold capacity before mail is delivered to a trash location **248** and/or mail pickup and/or drop-off location **244**. User input may include schedule and route information that describes the route, the date and time the robot **104** travels among the one or more locations and/or one or more commands to travel to a location. Other user input may include the confirmation and/or cancelling of one or more determinations, such as a determination to shred a piece of mail, a determination of an addressee for a piece of mail, and/or a determination that a piece of mail is junk mail.

Exemplary embodiments of the methods/systems have been disclosed in an illustrative style. Accordingly, the terminology employed throughout should be read in a non-limiting manner. Although minor modifications to the teachings herein will occur to those well versed in the art, it shall be understood that what is intended to be circumscribed within the scope of the patent warranted hereon are all such embodiments that reasonably fall within the scope of the advancement to the art hereby contributed, and that that scope shall not be restricted, except in light of the appended claims and their equivalents.

What is claimed is:

1. An automated mailbox, comprising:

an enclosure having:

a door that is configured to move between an open position and a closed position,

a first portion that is configured to receive a plurality of documents when the door is in the open position and where the plurality of received documents are placed,

a second portion that is adjacent to the first portion and that has a plurality of bins for storing the plurality of received documents, the plurality of bins including a first bin that is configured to store at least one document of the plurality of received documents, and

a letter sorting device that is configured to sort and move the at least one document from the first portion into the first bin in the second portion; and

a transportation component that is connected to the enclosure and configured to move in a plurality of directions.

2. The automated mailbox of claim **1**, further comprising:

a power source for providing energy;

a receptacle assembly configured to interface with and provide the energy to charge the power source; and

a navigation unit configured to provide navigation information including a current location.

3. The automatic mailbox of claim **1**, further comprising at least one of a GPS device or one or more ground beacons to navigate.

4. The automatic mailbox of claim **1**, further comprising a post connected to at least one of the enclosure or the transportation component and that vertically extends and retracts and includes an anchor that is configured to secure in a structural member to prevent movement of the automatic mailbox.

5. The automatic mailbox of claim **1**, wherein the enclosure includes:

one or more processors configured to:

determine that a first document of the at least one document is of a first type, and

cause the letter sorting device to move the first document to the first bin in response to determining that the first document is of the first type.

6. The automatic mailbox of claim **5**, wherein the one or more processors is further configured to:

capture, using a camera, an image of the first document; and

match one or more features of the first document to one or more attributes of the first type.

7. The automatic mailbox of claim **5**, wherein the transportation component is further configured to move among a plurality of locations including moving to a first location of the plurality of locations based on the first document being moved to the first bin.

8. The automatic mailbox of claim **7**, wherein the plurality of bins includes a second bin, wherein the one or more processors are further configured to:

determine that a second document of the plurality of documents is of a second type;

move the second document to the second bin for the second type;

shred the second document in the second bin; and

wherein the transportation component is further configured to move to a second location to dispose of the shredded second document.

9. A method for sorting and delivering mail, comprising:

obtaining, within a first portion of an enclosure of an automated mailbox at a first location, one or more pieces of mail, the one or more pieces of mail including a piece of mail being of a first type or a second type;

capturing, by a processor using a camera within the enclosure, one or more images of the piece of mail;

determining, by the processor, whether the piece of mail is of the first type or the second type based on the one or more images of the piece of mail; and

moving, using a letter sorting device within the enclosure, the piece of mail from the first portion of the enclosure to a first bin in a second portion of the enclosure if the piece of mail is of the first type;

determining, by the processor, that at least one piece of mail is in the first bin; and

transporting, using a transportation component connected to the enclosure, the at least one piece of mail from the first location to a second location.

10. The method of claim **9**, further comprising moving, using the letter sorting device, the piece of mail from the first portion of the enclosure to a second bin in the second portion of the enclosure if the piece of mail is of the second type.

11. The method of claim **10**, further comprising:

determining, by the processor and using the camera, that at least one piece of mail is in the second bin;

shredding, using a shredder, the at least one piece of mail in the second bin; and

transporting, using the transportation component, the at least one piece of mail in the second bin to a third location either from the first location or the second location.

12. The method of claim **11**, wherein the first type of mail is deliverable mail and the second type of mail is junk mail.

13. The method of claim **9**, wherein determining whether the piece of mail is of the first type or the second type further comprises:

identifying, by the processor and using the camera, one or more features of the piece of mail;

comparing, by the processor, the one or more features of the piece of mail to one or more attributes of the first type and one or more attributes of the second type; and

determining, by the processor, that the piece of mail is of the first type based on the comparison.

14. The method of claim **13**, wherein identifying the one or more features of the first piece of mail includes performing, by the processor, optical character recognition.

15. The method of claim **13**, wherein identifying the one or more features of the piece of mail includes analyzing, by the processor, the piece of mail for color or shape attributes.

16. The method of claim **13**, wherein the one or more attributes of the first type and the one or more attributes of the second type each have a weighting factor, wherein the weighting factor is user configurable.

17. The method of claim **16**, wherein determining that the piece of mail is of the first type is based on the comparison and the weighting factor of each of the one or more attributes of the first type and the one or more attributes of the second type.

18. An automated mailbox robot, comprising:

a base that foil is a foundation for the automated mailbox robot;

a mailbox connected to the base and having:

a door that is configured to move between an open position and a closed position, the mailbox configured to receive a document when the door is in the open position, and

a processor configured to determine that the document is of a particular type; and

a transportation component that is connected to the base and moves in a plurality of directions among a plurality of locations based on the particular type of the document that is received within the mailbox.

19. The automated mailbox robot of claim **18**, wherein the mailbox has a post coupled to the base, wherein the post vertically extends and retracts and includes an anchor that is configured to secure in a structural member to prevent movement of the automated mailbox robot.

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